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Range Expansion of the Cattle Egret (*Bubulcus ibis*) in the Greater Caribbean Basin

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Abstract.—The Cattle Egret (*Bubulcus ibis*) was first reported in the Greater Caribbean Basin from Old Providence Island in 1933. It was not reported again from the region until 1944, when an individual was sighted in Aruba, Southern Netherlands Antilles. Within 4 years, the species was reported in Puerto Rico and Jamaica more than 800 km north of Aruba in the Greater Antilles. By 1957, Cattle Egrets were successfully nesting in nearby Cuba and St. Croix. Today, the species is known from more than 50 major islands throughout the Caribbean Basin.

Cattle Egrets show strong dispersal tendencies and migratory behavior. The first Cattle Egrets to reach the Caribbean islands were probably migratory individuals. Rapid range expansion in the Caribbean and throughout the neotropics was concomitant with increased animal husbandry and intense agricultural practices, including irrigation and burning regimes. The success of the Cattle Egret in the Caribbean region is also attributed to its high reproductive rate, exponential population growth, extended breeding seasons, and few vertebrate predators, owing to the region's insularity.

Key words.—*Bubulcus ibis*, Caribbean Basin, Cattle Egret, first record, islands, neotropics, range expansion, West Indies.

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The Cattle Egret (*Bubulcus ibis*) is native to Africa, southern Portugal, Spain, the humid Asian tropics from India to Japan, and northern Australia (Brown et al. 1982). In the 1930s, the Cattle Egret began one of the most dramatic and best documented avian range expansions occurring in this century. First reports of the Cattle Egret in the Western Hemisphere were of visual accounts from South America. Cattle Egrets were sighted in British Guiana and Surinam in the years 1877, 1882, 1911, and 1912 (Blake 1939, Palmer 1962). However, a specimen was not secured from South America (British Guiana) until 1937 (Crosby 1972). The Cattle Egret then spread northward, and in 1943 a specimen was collected in the state of Guarico, Venezuela (Phelps 1944, 1946). Haverschmidt (1947, 1950, 1951, 1957) reported the species in Surinam by 1946. The Cattle Egret spread quickly westward and southward in South America. Although the Cattle Egret was well established in Colombia by the late 1950s (Dugand 1954, 1955, Lehmann 1959), Wetmore (1963) reported a possible record for that country as early as 1916 or 1917. The Cattle Egret was reported in Peru by 1956 (Stott 1957) and southwest to the Galapagos by 1960 (Leveque et al. 1966). However, it was not reported in Brazil, Chile, or Argentina for about

another decade, (Post 1970, Narosky 1973, Belton 1974).

Bubulcus ibis continued its western and northern spread in the 1950's and 1960's. It was reported in Costa Rica, Central America by 1954 (Slud 1957), Guatemala by 1958 (Land 1963), and in Quintana Roo, Mexico by 1959 (Denham 1959). It spread quickly through Mexico (Andrle and Antell 1961, Wolfe 1961, Edwards 1965, Dickerman 1964, Zimmerman 1973). By 1961, it was reported as far west as the Cocos and Clipperton islands, 920 km west of Central America (Lint 1962).

How the first Cattle Egrets reached the North American Continent will probably never be explained satisfactorily. Mansingh and Hammond (1978) suggest a transatlantic crossing from northwestern Africa to North America. However, as Blake (1961) has shown, such a route is highly unlikely because the Horse Latitudes (virtually no appreciable air movements in any direction) lie from Florida to about 40° N Lat., and the prevailing winds above 40° N are Westerlies, i.e., blowing in the opposite direction to the egrets' path. Owing to the large expanse of open ocean between North Africa and the North American continent, plus the wind countercurrents, it is very unlikely that North America's founding population of Cattle Egrets arrived directly

from Africa. It is more probable that, as Crosby (1972) has proposed, after establishing a foothold on the northeastern coast of South America, the Cattle Egret moved across the Caribbean Sea. *Bubulcus ibis* was reported from Old Providence in 1933 and then Aruba in 1944, both islands in the southern Caribbean Sea. Cattle Egrets were sighted in southern Florida as early as 1941 (Blaker 1971), and one was photographed near Lake Okeechobee, Florida, in 1952 (Sprunt 1955). The first North American specimen record was also collected in 1952 in Massachusetts (Drury et al. 1953). The Cattle Egret was reported as far North as Cape May, New Jersey by 1951 (Blake 1961).

The first breeding record for this species in the Western Hemisphere was reported in 1950 in Georgetown, Guyana (Lowe-McConnell 1967). It was reported nesting in Colombia by 1958 (Lehmann

1959) and as far south as Argentina by 1972 (Hancock and Elliott 1978). The first North American nesting record was reported in 1953 at King's Bar, Lake Okeechobee, Florida (Malin 1968), and Cattle Egrets were reported nesting as far North as Canada by 1963 (Buerkle and Mansell 1963).

Although the Cattle Egret's range expansion has been well summarized for North America and much of South and Central America (Haverschmidt 1953, Sprunt 1953, 1955, 1956a,b, Peterson 1954a,b, Barnes 1955, Rice 1956, Davis 1960, Meyerriecks 1960, Blake 1961, Lint 1962, Palmer 1962, Bump and Robbins 1966, Blaker 1971, Siegfried 1971c, 1978, Crosby 1972, Weber 1972, Hancock 1978, Hancock and Elliott 1978, Brown et al. 1982, Hancock and Kushlan 1984), except for a recent work by Telfair (1983), records of its colonization and the timing of

Table 1. Summary of museum reference collections of Caribbean, Caribbean slope, and southern United States specimens of the Cattle Egret.

Institution	Information	Collaborator
University of Miami (Coral Gables, FL)	100 skeletons and about 50 skins: most from southern Florida; many from Fla. Keys; 2 early specimens from So. Fla. (1953);	O. T. Owre
Florida State Museum (Gainesville, FL)	30 specimens: Florida (27, 12 from offshore cays, e.g., Dry Tortugas); South Carolina (3); Florida: 1958 (3), 1959 (4), 1960 (3), 1961 (6), 1962 (1), 1963 (1), 1964 (1), 1965 (2), 1967 (3), 1969 (1), 1979 (1), 1981 (1); South Carolina: (3, 1961);	T. A. Webber J. W. Hardy
Mus. Nat. Sci. (Louisiana State U., Baton Rouge, LA)	17 specimens: Texas (1, 1959); Louisiana (2, 1955, 1956); Alabama (1, 1962; Florida (2, 1954); Mexico (3, 1958, 1960, 1962); Belize (2, 1956); Guatemala (1, 1961); Honduras (3, 1963); Colombia (1, 1962); Peru (1, 1965);	J. V. Remsen A. Capparella
Amer. Mus. Nat. Hist. (New York, NY)	12 specimens: Florida (5, 1963); Guatemala (2, 1970); Colombia (2, 1961); Surinam (2, 1947); Trinidad (1, 1958);	A. V. Andors W. E. Lanyon
Albert Schwartz Collect. (Louisiana State U., Baton Rouge, LA)	11 specimens; Florida (1, 1960); Bahamas (4, 1960, '60, '61, '68); Cuba (4, 1959, 1960, 1960, 1960); St. Eustatius (2, 1962);	J. V. Remsen A. Capparella
Natl. Mus. Nat. Hist. (Washington, DC)	3 specimens: 1 skin: Tomanzeau, Haiti (1971); 2 skeletons: Great Inagua, Bahamas (1976) and Vieques Island, Puerto Rico (1980);	R. B. Clapp
Yale Peabody Museum (New Haven, CT)	3 specimens: 2 skins: Georgetown, British Guiana (1948) and D leau Gailliee, Haiti (1959); 1 pickled;	E. H. Stickney
Academy of Nat. Sciences (Philadelphia, PA)	no specimens from the region;	M. Robbins
Field Mus. Nat. Hist. (Chicago, IL)	no specimens from the region;	D. E. Willard
Museum of Zoology (University of Michigan)	no specimens from the region;	M. C. McKittrick

its dispersal throughout the Caribbean region have remained widely scattered in the literature. In this paper, I summarize the spread of the Cattle Egret throughout the Greater Caribbean Basin.

METHODS

I relied on a combination of survey methods to review the Cattle Egret's Caribbean range expansion. With the aid of on-line computer data banks (1950 to present), I surveyed more than 100 articles from pertinent literature in European journals describing the egret's traditional range and expansion in the Old World and about as many articles in North and South American journals outlining its range expansion in the New World. The Zoological Record (1960 to present) and Wildlife Review (1961 to present) were also reviewed. I also wrote to regional authorities such as Dr. James Bond. Finally, I wrote to major North American universities and museums that might have reference collections of the Cattle Egret from the Caribbean, Caribbean slope, and southern United States (Table 1).

RESULTS

Caribbean Range Expansion

The Cattle Egret spread rapidly through the Greater Caribbean area. Within 15 years after it was first reported in Old Providence (1933), the species was reported as far north as Puerto Rico (1948) and Jamaica (1948) in the Greater Antilles (Fig. 1, Table 2). Within 5 years, it was sighted in Eleuthera, Bahama Islands (1953) just southeast of the North American continent. It was reported nesting in St. Croix, U.S. Virgin Islands and Cuba 9 years after being reported in the Greater Antilles. Within 30 years after its first appearance in the region, the Cattle Egret was reported on more than 30 Caribbean islands, and presently is known from about 50 islands (Fig. 1, Table 2).

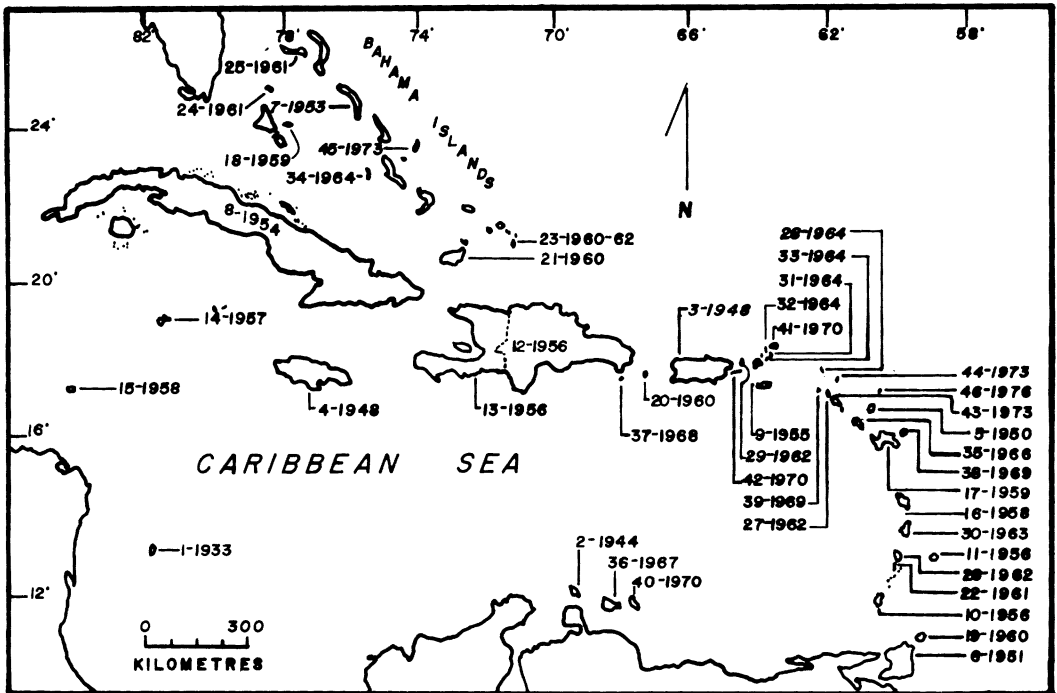


Figure 1. Range expansion of the Cattle Egret in the Greater Caribbean Basin. Islands are numbered in chronological order (by year) of first sightings: Old Providence (1), Aruba (2), Puerto Rico (3), Jamaica (4), Antigua (5), Trinidad (6), Eleuthera (7), Cuba (8), St. Croix (9), Grenada (10), Barbados (11), Dominican Republic (12), Haiti (13), Grand Cayman (14), Swan Island (15), Martinique (16), Guadeloupe (17), New Providence (18), Tobago (19), Mona (20), Great Inagua (21), Bequia (22), Grand Turk (23), Harbour Island (24), Grand Bahama (25), St. Vincent (26), St. Eustatius (27), St. Martin (28), Culebra (29), St. Lucia (30), Virgin Gorda (31), Tortola (32), St. John (33), Great Exuma (34), Montserrat (35), Curaçao (36), Saona (37), Desirade (38), Saba (39), Bonaire (40), Anegada (41), Vieques (42), St. Kitts (43), St. Bartholomew (44), San Salvador (45), Barbuda (46).

Table 2. First reports of individuals, nesting, and habitat associations of the Cattle Egret in the Greater Caribbean Basin.

Island	Date	Observations	Source
Old Providence	1933	(no information)	Bond (in litt.)
Aruba	1944	(no information)	Drury et al. (1953)
	21 Nov 1971	earliest subsequent record; ca. 12 on pond near the Windmill;	Voous (1983)
	Jul 1980	first breeding record;	Voous (1983)
Puerto Rico	1948	specimen taken, according to N. F. Leopold;	Bond (1968)
	15 Dec 1950	specimen collected at Cartagena Lagoon;	Bond (1964)
	1952	numbers estimated to be over 2,000;	Bond (1959)
Jamaica	1948	Miss Mae Jeffrey-Smith saw "a strange white heron" near Spanish Town; from description, both Jeffrey-Smith and Bond believe it was a Cattle Egret;	Bond (in litt.)
	21 Nov 1956	more than 20 birds feeding in a pasture among steers;	Bond (1957)
Antigua	"1950s"	found in pastures since the 1950s.	Holland and Williams (1978)
	Jan 1963	abundant;	Bond (1963)
Trinidad	1951	feeds in savannahs, marshes, and (rarely) salt-water areas and mudflats by day; roosts in mangrove swamps;	ffrench (1980)
Eleuthera Is.	1953	(no information)	Bond (1959)
Cuba	1954	(no information)	Bond (1959)
	24 Apr 1957	about 50 nesting pairs building nests in trees near a small bay;	Smith (1958)
St. Croix	21 Feb 1955	flock of 26 in a pasture feeding with cattle;	Seaman (1955)
	23 Apr 1957	10 individuals at a heronry in Krause Lagoon, St. Croix; 3 nests in mangrove islet;	Seaman (1958)
Grenada	1956	(no information)	Bond (1959)
Barbados	1956	(no information)	Bond (1959)
Dominican Republic	Jan 1956	(no information)	Bond (1956)
Haiti	23 Jan 1956	about 30 seen near Damiens; one-third of flock in breeding plumage;	Bond (1959)
	21 Jun 1956	flock (100 +) feeding in pasture with cattle;	Owre (1959)
Grand Cayman Is.	Jan 1957	(no information)	Bond (1959)
Swan Island	1958	(no information)	Bond (1959)
Martinique	Nov 1958	about a dozen feeding in pastures with cattle;	Pinchón (1961)
Guadeloupe	Feb 1959	(no information)	Bond (1959)
New Providence Is.	1959	(no information)	Bond (1959)
Tobago	"early 1960s"	(no information)	ffrench (1980)
	May 1962	(no information)	Bond (1963)
	1970	no evidence of nesting as yet (Native and Winter Resident birds of Tobago)	Bond (1970)
			ffrench (1980)

Table 2. (Continued).

Island	Date	Observations	Source
Mona Is.	May 1960	"several" seen at Sardinera;	Raffaele (1973)
Great Inagua	1960	two females;	Schwartz and Klinikowski (1963)
Bequia	17 Dec 1961	4 observed;	Schwartz and Klinikowski (1963)
Grand Turk	"1960-1962"	one male;	Schwartz and Klinikowski (1963)
Harbour Is.	Nov 1961	(no information)	Bond (1962)
Grand Bahama Is.	23 Nov 1961	(no information)	Bond (1962)
St. Vincent	3 Feb 1962	2 seen among cattle in pasture near airport;	Bond (1962)
St. Eustatius	2 Apr 1962	two females with large follicles shot from a flock of six;	Schwartz and Klinikowski (1963)
St. Martin	8 May 1962 May 1973	(no information) first recorded breeding in rhizophore mangroves, Bay d'Orleans;	Schwartz and Klinikowski (1963) Voous (1983)
	11 Jan 1975	at Bay d'Orleans, 300 nesters were observed and photographed;	Hoogerwerf (1977)
Culebra Is.	7-12 Nov 1962	(no information)	Heatwole et al. (1963)
St. Lucia	1963	"flock" in the north, stayed only a few days;	Bond (1964)
Virgin Gorda	19 Aug 1964	4 birds observed at Little Dix Bay;	Schwartz and Klinikowski (1965)
	1976	up to 9 birds were seen;	Mirecki (1977)
Tortola	10 Aug 1964	flock of 12 seen east of Roadtown;	Schwartz and Klinikowski (1965)
	1976	roost of 50 or more birds;	Mirecki (1977)
St. John	1964	(no information)	Bond (1965)
Great Exuma Is.	Jan 1964	"several";	Bond (1964)
Montserrat	May 1966	(no information)	Bond (1968)
Curaçao	18 May 1967	"Individuals" on grassy limestone plateau;	Voous (1983)
	25 Jun 1967	15-20 pairs on Isla Macuacu, Sint Joris Bay;	
	Oct 1976	flock of 400 feeding on grasshoppers at airport;	
Saona Is.	Dec 1968	5 birds feeding in trash & garbage behind Mano Juan;	Schwartz (1969)
Desirade	1969	single bird among goats (presumably in a pasture);	Guth (1971)
Saba	1969	(no information)	Seaman <i>In</i> : Voous (1983)
Bonaire	27 Jan 1970	flock of 16 seen at Great Salt Lake;	
	30 Dec 1974	earliest subsequent record, when a flock of 26 landed on jetty; observed annually; no resident pop.; no nestings;	
Anegada	1970	a "few" in mangrove swamps;	LaBastille (1973)
Vieques Is.	18 Jun 1970	(no information) thought to be present from the mid-1950s; roost and nest in mangroves;	Sorrie (1975)
St. Kitts	1973	"abundant";	Bond (1973)
St. Bartholomew	1973	(no information)	Bond (1973)

Table 2. (Continued).

Island	Date	Observations	Source
San Salvador (Watling's Is.)	Dec 1973	(no information)	Bond (1978)
Barbuda	4 Jan 1976	(no information)	Bond (1976)

DISCUSSION

The rapid spread of the Cattle Egret throughout the New World in general, and the Caribbean region in particular, can be attributed to many factors. *Bubulcus ibis* possesses many inherent characteristics that make it preadapted to an array of ecological and environmental conditions.

Migration and Movements

Members of the family Ardeidae are strong fliers, many species migrating thousands of kilometers each year (Downs 1959, Brown et al. 1982). The Cattle Egret is no exception (Hancock 1978). It shows strong migratory and dispersal tendencies (Glass and Woodell 1957, Siegfried 1970, Hancock and Elliott 1978, Brown et al. 1982). Young are known to disperse up to 5,000 km from their natal area (Browder 1973). In the Old World, flocks have been observed far out in the Mediterranean and Red Seas, and the Gulf of Aden (Bailey 1966). In the New World, flocks have been observed in the mid-Atlantic (Barnes 1955, Bowen and Nicholls 1968). The Cattle Egret has dispersed over distances as great as Asia to Australia (Sprunt 1955, Harrison and Howell 1975), and has even reached New Zealand (Brown 1980). *Bubulcus ibis* shows a strong resistance to altitudinal changes in oxygen levels, being sighted at heights in excess of 3,500 m in the Andean Plateau of Peru (Crosby 1972). Cattle Egrets crossing the Atlantic Ocean from Africa to South America are thought to take advantage of prevailing winds (Blake 1961, Strange 1979).

The Cattle Egret often flocks with interspecifics during migration, especially Snowy (*Egretta thula*) and Little Blue (*Egretta caerulea*) Herons (Barnes 1955, Rice 1956, Hancock and Elliott 1978). Rice (1956) suggested that the first Cattle Egret immigrants to North America may have arrived with other migrating herons returning

from South American wintering grounds. Migrating herons might have directly bypassed Caribbean islands during their yearly treks to and from South America. Such direct migrations would have been independent of the egret's northward spread through the West Indies. However, evidence suggests that North America's first Cattle Egrets arrived via a Caribbean migration route. Flocks of Cattle Egrets that visit the Dry Tortugas off Florida's southern coast each fall and winter are migrants from the West Indies (Harrington and Dinsmore 1973). Cattle Egrets banded in Georgia have been recovered in Cuba (Hopkins 1972). Moreover, migratory Snowy and Little Blue Herons banded in Mississippi have been recovered in Guadeloupe, West Indies (Coffey 1943). That the first Cattle Egrets reported in Old Providence in 1933 and Aruba in 1944 were probably Caribbean migrants and not resident individuals, is exemplified by the fact that the species was not reported breeding in Aruba until 1980 (Voous 1983). Also, on nearby Bonaire, although the Cattle Egret was first reported from the island in 1970, there has been no signs of a resident population or nesting by this species (Voous 1983). Moreover, the Cattle Egret's appearance in Puerto Rico only four years after it was first reported in Aruba, a distance of some 800 km, further suggests an early Caribbean migration route. These facts suggest that, since their arrival to the New World, migratory Cattle Egrets have passed through the Caribbean in association with other ardeids en route to northern latitudes, thus substantiating an early West Indian migration route that eventually facilitated colonization of Caribbean islands.

Adaptation to Disparate Habitats

The Cattle Egret is adapted to roost, breed, and forage in both aquatic and terrestrial habitats (Meyerriecks 1962, Palmer

1962, Custer and Osborn 1978, Hancock and Elliott 1978, Siegfried 1978, Strange 1979, Brown et al. 1982, Telfair 1983). *Bubulcus ibis* has been said to inhabit the ecotone between terrestrial and aquatic biotopes (Siegfried 1978). Shortly after its establishment in the Western Hemisphere, the Cattle Egret was reported roosting in low bushes along rivers in Surinam (Haverschmidt 1947), and nesting in trees about 90 m from a farm house in Colombia, South America (Lehmann 1959). Many Caribbean islands are well suited to the egret's preadaptation to nesting and roosting in marine environments (i.e., coastal and tidal mangrove forests), and foraging in more terrestrial biotopes such as agricultural lands and urban areas (e.g., gardens, school playgrounds, sports playing fields).

The Cattle Egret's innate ability to forage in tide pools (Bowen and Nicholls 1968) and along shorelines (Strange 1979) on small pelagic islands undoubtedly facilitated its transatlantic crossing and spread through the Caribbean islands.

Continued Habitat Alteration

The Cattle Egret has extended its range in response to widespread habitat alteration and animal husbandry practices on a cosmopolitan scale (Sprunt 1955, Davis 1960, Blaker 1971, Crosby 1972, Browder 1973, Bock and Lepthien 1976). In South America, widespread deforestation for timber production in the late 1800s, and continued habitat alteration for the establishment of cattle rangeland that began on a large scale in South America in the 1940s and 1950s, greatly enhanced the egret's rapid spread over that continent. Blaker (1971) reported a 350% increase in the number of Cattle in South America between 1910 and 1960.

As in South America, the Cattle Egret's rapid colonization of West Indian islands can probably be attributed, at least in part, to the conversion of forests and croplands to cattle ranges during the years following the collapse of the sugar cane and cotton industries throughout the Caribbean (Myers 1979). On Caribbean islands, native forests were felled as early as the sixteenth and seventeenth centuries for agricultural purposes, leaving most islands denuded of native vegetation. In the 1940s

and 1950s, the high price of beef on the world market induced islanders to convert much agricultural land to rangeland, thus creating suitable habitat for the newly arrived Cattle Egret. The elimination of free-ranging cattle, i.e., the formation of cattle herds within fenced-off pastures, has caused a higher density of cattle per unit area and, as suggested by Hancock (1978), has created a higher density of insect prey that may help young, novice Cattle Egrets find enough food to survive.

The creation of short grass meadow has also facilitated the Cattle Egret's spread throughout many parts of the world (Siegfried 1978). Fire, both natural and man-induced, maintains the short grass meadows that are conducive to foraging Cattle Egrets. Although sugar cane is no longer grown on a large scale in the Caribbean, it is still planted on many islands and fields are burned each year after harvest. At this time, sugar cane fields make a favorite foraging habitat for Cattle Egrets. Even today on many Caribbean islands, Cattle Egrets often can be seen stalking invertebrate and vertebrate prey fleeing from the flames of advancing cane fires.

Most Caribbean islands are "tourist islands". Their economies depend on the tourist industry. In attracting tourists, many developers create short grass meadows in the form of large, sprawling landscaped lawns and golf courses, often through the aid of irrigation, thus creating a foraging niche for local populations of the Cattle Egret. Few visitors to the Caribbean islands have not observed foraging Cattle Egrets on the golf courses and grounds of luxurious vacation resorts and hotels.

Increased Use of Irrigation

Siegfried (1978) reported that the rapid spread of the Cattle Egret throughout the world was not so dependent upon an increase in cattle and rangeland as it was on the construction of river impoundments and intense irrigation systems, especially in xeric coastal areas. Many South American and Caribbean inhabitants depend on rice as a staple in their diets. Deforestation for the production of rice has created a suitable foraging niche for Cattle Egret populations in both mesic and xeric

lowlands of both regions. Irrigation systems employed in rice fields have greatly increased total acreage under rice production in both regions (Blaker 1971), thus offering more foraging habitat to local Cattle Egret populations.

Diet and Foraging

The Cattle Egret is omnivorous, feeding mostly on insects (Palmer 1962, Skead 1963, Blaker 1965, Siegfried 1966b, Burns and Chapin 1969, Hanebrink 1971, Siegfried 1971b, Weber 1972, Fogarty and Hetrick 1973, Smalley 1979). However, it is known to take amphibians (Siegfried 1966b, 1978, Hanebrink 1971, Fogarty and Hetrick 1973), reptiles (Hanebrink 1971, Fogarty and Hetrick 1973), birds (Harrington and Dinsmore 1973, Van Ee 1973, and mammals (Cunningham 1965, Siegfried 1971b, Fogarty and Hetrick 1973). Contrary to popular belief, the Cattle Egret seldom eats ticks (North 1945, Beven 1946, Cockburn 1946, Holman 1946, Skead 1956, Palmer 1962). However, Mansingh and Hammond (1978) report Cattle Egrets frequently feeding on ticks in Jamaica.

Many New World cities and Caribbean islands are overpopulated. The number and size of city dumps and refuse piles are ever-increasing throughout the New World. The Cattle Egret is adapted to foraging on insects at refuse sites (Schwartz 1969), and often can be seen by the hundreds congregating at local dumps and trash piles. As with an increase in the density of insect prey produced by forcing cattle together in small areas, refuse piles may be a foraging site at which young, inexperienced Cattle Egrets can be assured of obtaining enough food for survival.

The Cattle Egret's feeding association with other animals (mostly browsers and grazers) and machinery is well known and has been well documented (Peterson 1954, Meyerriecks 1960, Baillie 1963, Blaker 1971, Weber 1972, Duffy 1973, Custer and Osborn 1978, Thompson et al. 1982). With the introduction of livestock into the Americas by the Spanish in the sixteenth century (Blaker 1971), the stage was set for the subsequent arrival of the Cattle Egret. Of 16 reported first sightings of the Cattle Egret in the Western Hemisphere, 14 (88%) were of egrets in company of graz-

ing animals (Haverschmidt 1947, Dugand 1955, Seaman 1955, Rice 1956, Stott 1957, Denham 1959, Owre 1959, Slud 1957, Smith and Land 1960, Land 1963, Edwards 1965, Harrison and Howell 1975, Hoogerwerf 1977, Strange 1979). The other two sightings were of Cattle Egrets foraging in rice fields (Phelps 1946, Lehmann 1959). It has been shown that Cattle Egrets foraging in the company of grazing animals and machinery expend less energy and consume more food per unit time and area than individual egrets feeding alone (Heatwole 1965, Dinsmore 1973, Grubb 1976). It has even been suggested that the Cattle Egret forms a facultative commensalism with its foraging counterparts or operating machinery (Hanebrink 1971).

High Reproductive Success

Populations of the Cattle Egret show exponential growth patterns (Nicholson 1954, Baillie 1963, Laird et al. 1965). Analysis of Christmas Bird Counts has demonstrated this pattern in North America (Bock and Lepthien 1976, Larson 1982). Cattle Egrets can breed in their first year (Siegfried 1966a) and are efficient in converting ingested food into biomass (Siegfried 1971a), often times being more efficient than many interspecifics (Shanholtzer 1972).

Mixed species heronries act as information centers in encouraging individual birds to commence breeding (Custer and Osborn 1978). Cattle Egrets nest in mixed-species heronries and are often more successful and have higher reproductive success rates than other nesting ardeids (Lowe-McConnell 1967, Jenni 1969, Werschkul 1977, Burger 1978, 1982, Telfair 1980). Upon their arrival to the New World, propagule populations of Cattle Egrets breeding in company with interspecifics are thought to have had a higher reproductive success, due to the added stimulus of other nesters, than if they had nested alone (Barnes 1955). This was evidenced when Cattle Egret propagules nested successfully in mixed species heronries in Ghana in 1958 and 1959 (Bowen et al. 1962). Similarly, in the West Indies, Seaman (1958) observed that propagule Cattle Egrets were accepted into and successfully reproduced in a traditional

mixed-species heronry in St. Croix in 1957.

High reproductive success and long, often tropical, breeding seasons are thought to have enhanced the spread of the Cattle Egret in the New World (Weber 1972). In insular situations such as those found in the Caribbean Basin, Cattle Egrets suffer less mortality from predation, owing to a paucity of natural enemies (e.g., bird hawks and falcons), than do continental egret populations (Skead 1956).

Interspecific Compatibility and Economic Impact

Cattle Egrets show an inherent compatibility with both intra- and interspecifics. Meyerriecks (1962) showed that, because of their mostly terrestrial foraging habits, Cattle Egrets do not generally compete with other ardeids for food. In Georgia, Shanholtz (1972) reported that Cattle Egrets nested in mixed-species heronries with little or no competition for nesting resources, although this has been questioned recently (see Werschkul 1977, Telfair 1983). Sprunt (1955) pointed out that Cattle Egrets are beneficial to the cattle industry because they eat insects that crop back the grass of grazing animals.

In summary, a host of endogenous and exogenous factors such as the Cattle Egret's strong dispersal tendencies and migratory habits, coupled with its preadaptation to many disparate habitat types (many created by humans) have acted synergistically in facilitating the spread of *Bubulcus ibis* throughout the New World, including the Greater Caribbean Basin. Continued settlement and development throughout the neotropics and the Caribbean region will enhance Cattle Egret numbers in these areas in the coming years.

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